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PROFILING IN THE ARCTIC OCEAN

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## SOME RESULTS OF MAGNETOTELLURIC PROFILING IN THE ARCTIC OCEAN

[Article by I. L. Trofimov and G. A. Fonarev; Moscow, Izvestiya Akademii Nauk SSSR, Fizika Zemli, Russian, No 2, 1972, submitted 5 October 1970, pp 81-82]

A distinguishing characteristic of a marine geological cross section is the presence of a layer of sediments in its upper part [1], in contact on the one side directly with the water and on the other side with high-impedance rocks of the crystalline basement. The resistivity of marine sediments is greater than the resistivity of sea water, but the order of magnitude is the same [2]. The first marine magnetotelluric soundings (MTS), made from the drifting ice in the Arctic Ocean, revealed that the total longitudinal conductivity  $S$  obtained in an interpretation of the ascending branch of the impedance curves is greater than the total longitudinal conductivity of the sea water layer  $S_1$  [3,4]. This is attributable to the presence of a well-conducting sedimentary layer having a total longitudinal conductivity  $S_2$  equal to the difference  $S_2 = S - S_1$ . Study of the  $S_2$  distribution can be called marine magnetotelluric profiling (MMTP).

We have data on magnetotelluric observations made from the drifting ice in several regions of the Arctic Ocean.

During 1962-1963 such observations were made on the "Severnnyy Polyus" drifting station in the region of the Lomonosov Ridge and during 1967-1968 in the region of the Chukotskiy arch and the abyssal Amundsen Basin. We constructed a map of the total longitudinal conductivity of the sedimentary layer  $S_2$  for the central part of the Lomonosov Ridge. Map compilation was based on an interpretation of the ascending branch of about 80 MTS curves constructed for two mutually perpendicular directions. For most of the curves the impedance values  $\rho_{app}$  in both directions coincide, evidence of the geo-

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electric homogeneity of the cross section. The discrepancy observed for a small number of curves was insignificant. In these cases the MTS curve was constructed by the mean impedance method [5]. The ascending branch for all the curves has a slope of about  $63^{\circ}25'$  and the  $S$  value was determined along it. The total longitudinal conductivity of the sedimentary layer  $S_2$  was determined using the formula  $S_2 \approx S - h_1/\rho_1$ .

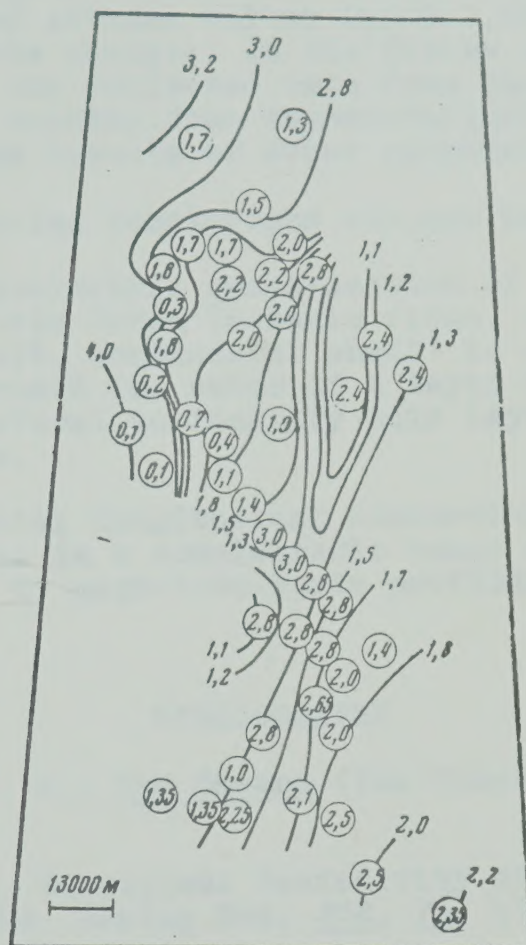



Fig. 1. Map of total longitudinal conductivity of sea sedimentary deposits for the central part of the Lomonosov Ridge.

The ocean depth  $h_1$  was known from the results of depth measurements with an accuracy to  $\sim 1\%$ . The resistivity of sea water  $\sigma_1$  was computed from measurements of water salinity and temperature and was 0.37 ohm·m. The maximum error in determining  $S_2$  was 20%; the mean error was 10%. The  $S_2$  map is shown in the figure. The  $S_2$  map carries solid lines which represent isobaths. The figures on the isobaths give the ocean depth in kilometers. The  $S_2$  value is given by the figures in



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the circles and is expressed in units km/ohms·m. The map shows that  $S_2$  varies in a considerable range, attaining maximum values in the arched part of the ridge. As a result of such a distribution of sedimentary deposits, despite considerable changes in ocean depths, there is a high geoelectric homogeneity of the cross-section, as noted above.

In the region of the Chukotskiy arch and in the Amundsen Basin  $S_2$  also attains values 2,500-3,000 mho and experiences considerable changes. In the future a detailed analysis will be made of the collected data from the geological point of view and the results from magnetotelluric profiling will be compared with the results of other geophysical methods.

The following conclusions can now be drawn:

1. The geoelectric cross-section of underwater structures in the Arctic Ocean (oceanic ridge, abyssal oceanic basin, arched uplift, continental shelf) is characterized by the presence beneath the water of a layer having good conductivity. It is natural to identify this layer with the layer of marine sediments.

2. The total longitudinal conductivity of the sedimentary layer varies in a considerable range and is determined quite precisely by magnetotelluric profiling.

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